Using dental growth rings scientists reveal differences in growth patterns between ancient and modern mammals

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A study published in *Science Advances* reveals how early mammals grew and developed during their pivotal Jurassic radiation. Using a technique

called synchrotron X-ray tomography to image growth rings in fossilized tooth roots, the researchers were able to estimate lifespans, growth rates, and even the timing of sexual maturity in these ancient creatures.

"This is the first time we've been able to reconstruct the growth patterns of these early mammals in such detail," said Dr. Elis Newham, a Postdoctoral Research Associate at Queen Mary University of London and Alexander von Humboldt research fellow at the University of Bonn, first author of the study.

"By studying the spacing and texture of these growth rings, we can not only tell how fast they grew at different stages of life, but also make inferences about their metabolism and overall life history."

The findings challenge previous assumptions about the growth patterns of mammal ancestors and suggestions that these animals may have grown more similarly to modern mammals. Instead, this paper answers the question posed by similar recent studies of early mammal ancestors: "When did the modern mammal life history evolve?"

The researchers found that the first signs of the modern mammal growth pattern (high growth rates in young animals that are arrested at puberty) originated among the earliest true mammals around 130 million years ago, in comparison with relatively little change through life in earlier evolving "mammaliaforms."

However, like mammaliaforms, these animals still grew more slowly and lived for much longer than living small mammals like rats and mice, reaching maximum lifespans anywhere between eight to 14 years-of-age. The timing of this growth rate change, alongside changes in the structure of growth rings, indicates when these animals underwent puberty, and potentially when they became sexually mature.

"This data suggests that while living small-bodied mammals are sexually mature within months from birth, the earliest mammals took several years to reach sexual maturity, corroborating recent findings for one of our studied animals, Krusatodon," Said Dr. Pam Gill, co-lead of the study and Scientific Associate at the Natural History Museum London and University of Bristol.

"We further find here that this long, drawn out life history was common among early mammals all the way through the Jurassic."

"These results suggest that the unique life history traits of mammals, like high metabolic rates and extended parental care, evolved gradually over millions of years," explains Dr. Newham. "The Jurassic period appears to be a pivotal time in this evolution."

The research team used a technique called synchrotron X-ray tomography to image tiny growth rings in fossilized root cementum, the bony tissue attaching teeth to the jaw. These rings are similar to those found in trees, but on a microscopic scale. By counting the rings and analyzing their thickness and texture, the researchers were able to reconstruct the growth patterns and lifespans of these extinct animals.

"This study is a great example of how new technologies are revolutionizing our understanding of the deep past," says Professor Thomas Martin of the University of Bonn, a senior co-author of the study. "By peering into these fossilized teeth, we can gain valuable insights into the lives of creatures that lived millions of years ago."

Dr. Jen Bright, co-author of the study and Zoology program director at the University of Hull, added, "It's been so exciting to be involved in this project. Putting Jurassic fossils into a particle accelerator (the synchrotron) and reconstructing the past from it sounds like science fiction, but we can actually do it."

This study involved members from Queen Mary University of London, The University of Bonn, The Natural History Museum London, the University of Helsinki, the Geological Survey of Finland, the University of Hull, the European Synchrotron Radiation Facility (France), the University of Southampton, the College of Osteopathic Medicine (United States), the University of Bristol, and the University of Edinburgh.

More information: Elis Newham et al, The origins of mammal growth patterns during the Jurassic mammalian radiation, *Science Advances* (2024). DOI: 10.1126/sciadv.ado4555.
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